



Chapter 9 **Air Quality Impact Analysis**

Air Quality Impact Analysis

Chapter 9

2

Introduction

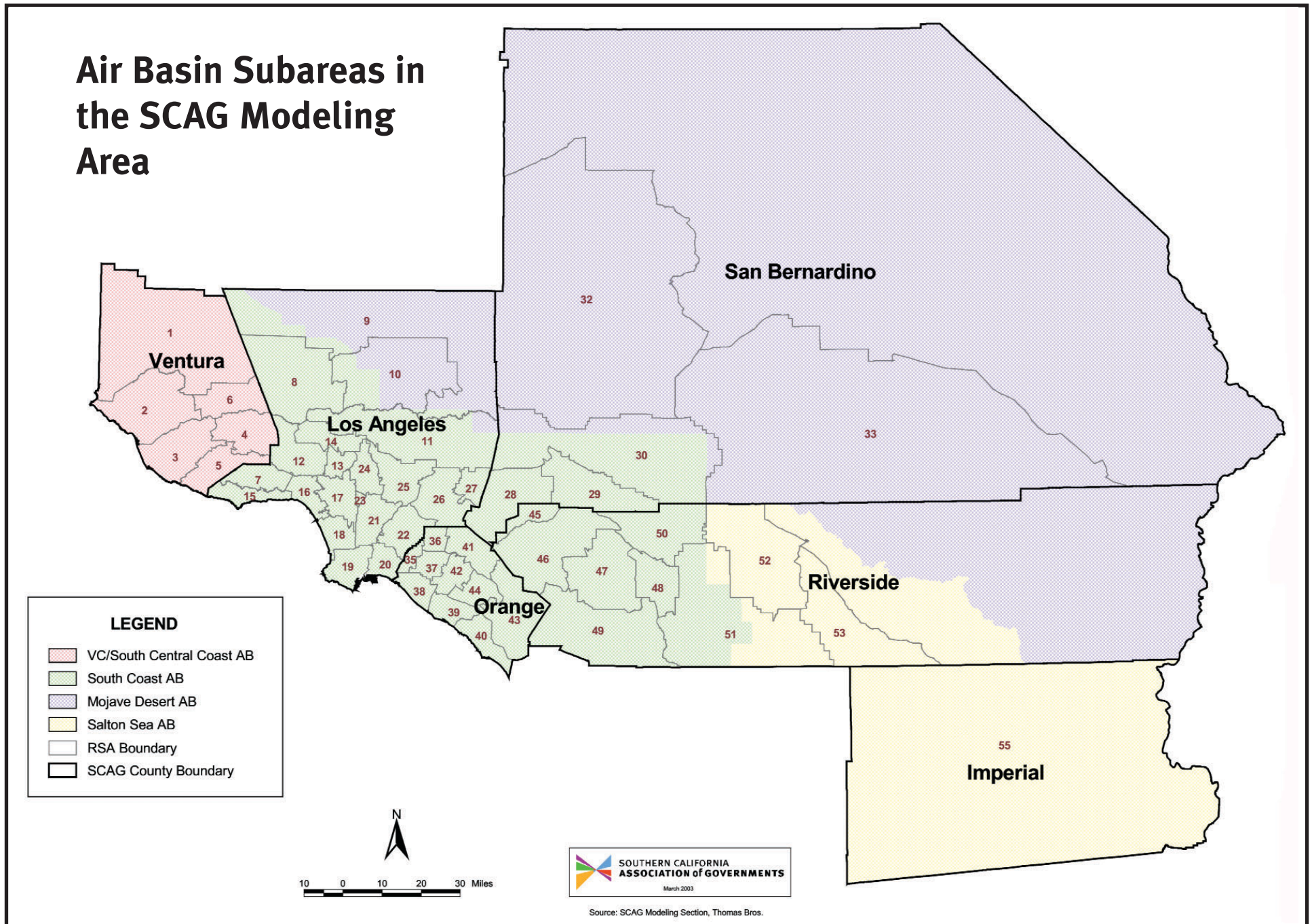
Transportation conformity analyses are conducted for non-attainment areas in each air basin /air district within the SCAG Region. Prior to January 1, 1977, there were three air basins and four air districts in the SCAG Region. Effective January 1, 1977, in accordance with Assembly Bill (AB) 421, the Southeast Desert Air Basin (SEDAB) was divided into two new air basins: the Mojave Desert Air Basin (MDAB) and the Salton Sea Air Basin (SSAB). AB 2666 established a new air district – the Antelope Valley Air Pollution Control District (AVAPCD) in the desert portion of Los Angeles County. The boundaries of the air basins and the air districts in the Region are illustrated in Figure 9-1. A summary of the air basins and five districts in the SCAG Region are presented below.

- **South Coast Air Basin (SCAB)** covers the urbanized portions of the Los Angeles, Orange, Riverside, and San Bernardino Counties and is within the jurisdiction of the South Coast Air Quality Management District (SCAQMD).
- **Ventura County portion of the South Central Coast Air Basin (SCCAB)** covers the entire Ventura County and is within the jurisdiction of the Ventura County Air Pollution Control District (VACAPCD).
- **Mojave Desert Air Basin (MDAB)** covers the desert portions of Los Angeles, Riverside, and San Bernardino Counties. A small portion of this air

basin is in Kern County and outside of the SCAG Region. The SCAG portion of this air basin is under the jurisdiction of three air districts including:

- **Mojave Desert Air Quality Management District (MDAQMD)** administers portions of the MDAB located within San Bernardino County and the eastern part of Riverside County. The Riverside County portion is known as the Palo Verde Valley area.
- **South Coast Air Quality Management District (SCAQMD)** administers a portion of the MDAB in Riverside County that is situated between the SSAB and the Palo Verde Valley area.
- **Antelope Valley Air Pollution Control District (Antelope APCD)** administers the Los Angeles County portion of the MDAB.
- **Salton Sea Air Basin (SSAB)** covers all of Imperial County and the eastern desert portion of Riverside County. This air basin is under the jurisdiction of two air districts including:
- **Imperial County Air Pollution Control District (ICAPCD)** administers the Riverside County portion of the SSAB.
- **South Coast Air Quality Management District (SCAQMD)** administers the Riverside County portion of the SSAB located situated between SCAB and the MDAB.

Figure 9-1



Regional Emissions Analysis

The Direct Travel Impact Model (DTIM) developed by Caltrans is used to calculate amounts of air pollutant emitted from motor vehicles and fuel consumption. The DTIM analysis is based on travel data produced by the SCAG Regional Model and on emission factors from the State's Emission Factor (EMFAC) Model. Pollutants estimated by DTIM include total organic gases (TOG), carbon monoxide (CO), oxides of nitrogen (NOX), and particulate (PT). The type of emissions consist of:

- Running vehicle engine exhaust missions operating in a hot established mode (i.e.: vehicles that have been running for some time and are completely warmed up).
- Trip end emissions such as cold starts (i.e.: when a vehicle engine is first started after cooling down to the ambient temperature), hot starts (when a vehicle is being restarted), or hot soak (when a vehicle is parked and running).
- Diurnal breathing emissions that result from evaporation in the fuel tanks.

DTIM Inputs

DTIM and its related programs were used to calculate emissions for the Year 2000 Model Validation Run. Transportation data inputs to the DTIM program include:

- Highway link information including volumes, distance, and congested speed from the highway assignment model.
- Trip-end information.
- An intra-zonal trip (trips that never leave the zone) file including average trip distance and time.
- Percentages of cold starts, hot starts, hot soaks, and parked vehicles.

Table 9.1 summarizes vehicle on-road emissions for light-and-medium duty vehicles for that portion of each air basin within the Region. Table 9.2 summarizes vehicle on-road emissions for heavy-duty vehicles for the portion of each air basin in the Region.

Figure 9-2 shows the carbon monoxide emissions by (5KM by 5KM) grid cells. The height of the bar represents the emission level. The resulting grid emissions data are included in SCAQMD's air quality model.

Table 9-1

LIGHT AND MEDIUM DUTY VEHICLE ON-ROAD EMISSIONS (EMISSION IN TONS, FUEL IN 1000-GALLONS)

SUB AREA	TOTAL ROG	TOTAL NOX	TOTAL CO	PM ₁₀	SOX	FUEL	DAILY VMT
Los Angeles	179.896	183.767	1433.347	5.223	13.406	7,660.441	180,677,500.12
Orange	63.285	67.672	508.786	1.880	4.825	2,757.356	64,931,413.32
Riverside	25.934	31.758	232.794	0.840	2.155	1,231.319	28,996,356.14
San Bernardino	26.133	29.954	220.960	0.783	2.010	1,148.405	27,043,122.57
South Coast AB	295.249	313.152	2,395.886	8.726	22.396	12,797.521	301,648,392.15
Ventura	15.566	17.545	130.263	0.444	1.141	651.719	15,333,491.33
Antelope Valley	5.485	6.316	46.150	0.166	0.427	243.976	5,744,036.41
Victor Valley +	8.365	9.943	78.900	0.257	0.661	377.448	8,884,369.16
Coachella Valley	9.248	10.580	86.824	0.253	0.648	370.468	8,719,709.72
Total Area	333.914	357.536	2,738.022	9.847	25.272	14,441.132	340,329,998.77

Note :

Socioeconomic Date: Year 2000

Light and Medium Duty Vehicles

SOX = Fuel * 0.00175

Transportation System: Year 2000

PM₁₀ = Exhaust + Tire Wear + Brake Wear

ROG = Tog1 * 0.9147 + Tog2 * 0.8277 + Tog3 * 0.9716 + Evap

TMFo1 D:\Dtim3\oovM_p.inq

TMFo3 D:\Dtim3\oovM_izpm

TMFo2 D:\Dtim3\oovM_iz.md

TMFo2 D:\Dtim3\oovM_iz.am

TMFo1 D:\Dtim3\oovM_o.inq

TMFo3 D:\Dtim3\oovM_iz.nt

Emission Factors =

Vehicles Used in Dtim3 = 11,678,000

Number of Zones = 3191 Banning area is included in Coachella Valley

Table 9-2

HEAVY-DUTY TRUCKS ON-ROAD EMISSIONS (EMISSION IN TONS, FUEL IN 1000-GALLONS)

SUB AREA	TOTAL ROG	TOTAL NOX	TOTAL CO	PM ₁₀	SOX	FUEL	DAILY VMT
Los Angeles	10.411	103.134	105.716	5.055	3.243	1,852.943	11,219,400.10
Orange	2.923	29.382	29.554	1.446	0.928	530.175	3,205,715.39
Riverside	1.492	18.351	16.843	0.827	0.530	303.136	1,832,931.03
San Bernardino	1.484	18.253	16.620	0.818	0.525	299.721	1,811,000.25
South Coast AB	16.309	169.119	168.732	8.146	5.225	2,985.975	18,069,046.78
Ventura	0.633	6.887	6.633	0.325	0.208	119.130	720,040.63
Antelope Valley	0.240	2.737	2.565	0.128	0.082	46.955	283,940.82
Victor Valley +	1.101	15.270	13.404	0.646	0.414	236.757	1,431,049.36
Coachella Valley	0.976	14.674	12.533	0.575	0.369	210.650	1,271,378.42
Total Area	19.259	208.687	203.868	9.820	6.299	3,599.468	21,775,456.01

Note :

Socioeconomic Date: Year 2000

Transportation System: Year 2000

Heavy-Duty Vehicles

PM₁₀ = Exhaust + Tire Wear + Brake Wear

SOX = Fuel * 0.00175

ROG = Tog₁ * 0.9147 + Tog₂ * 0.8277 + Tog₃ * 0.9716 + Evap

TMFo1 D:\Dtim3\oovH_p.1nq

TMFo2 D:\Dtim3\oovH_iz.am

TMFo3 D:\Dtim3\oovH_izpm

TMFo1 D:\Dtim3\oovH_o.1nq

TMFo2 D:\Dtim3\oovH_iz.md

TMFo3 D:\Dtim3\oovH_iz.nt

Emission Factors = G2000H.IRS

Vehicles Used in Dtim3 = 336,308

Number of Zones = 3191 Banning area is included in Coachella Valley

Figure 9-2

Carbon Monoxide Emission

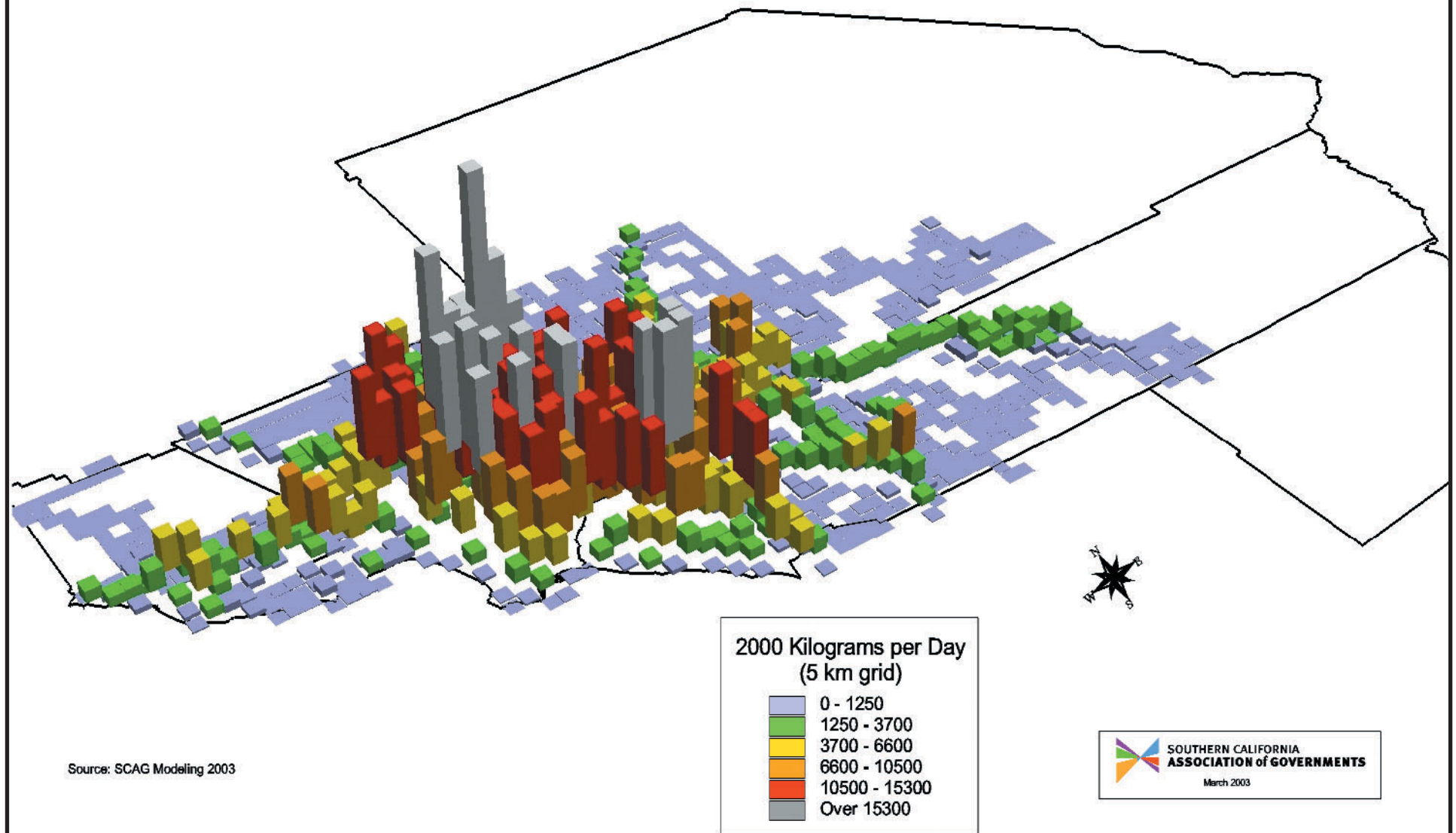


Figure 9-3

Total Organic Gases Emission

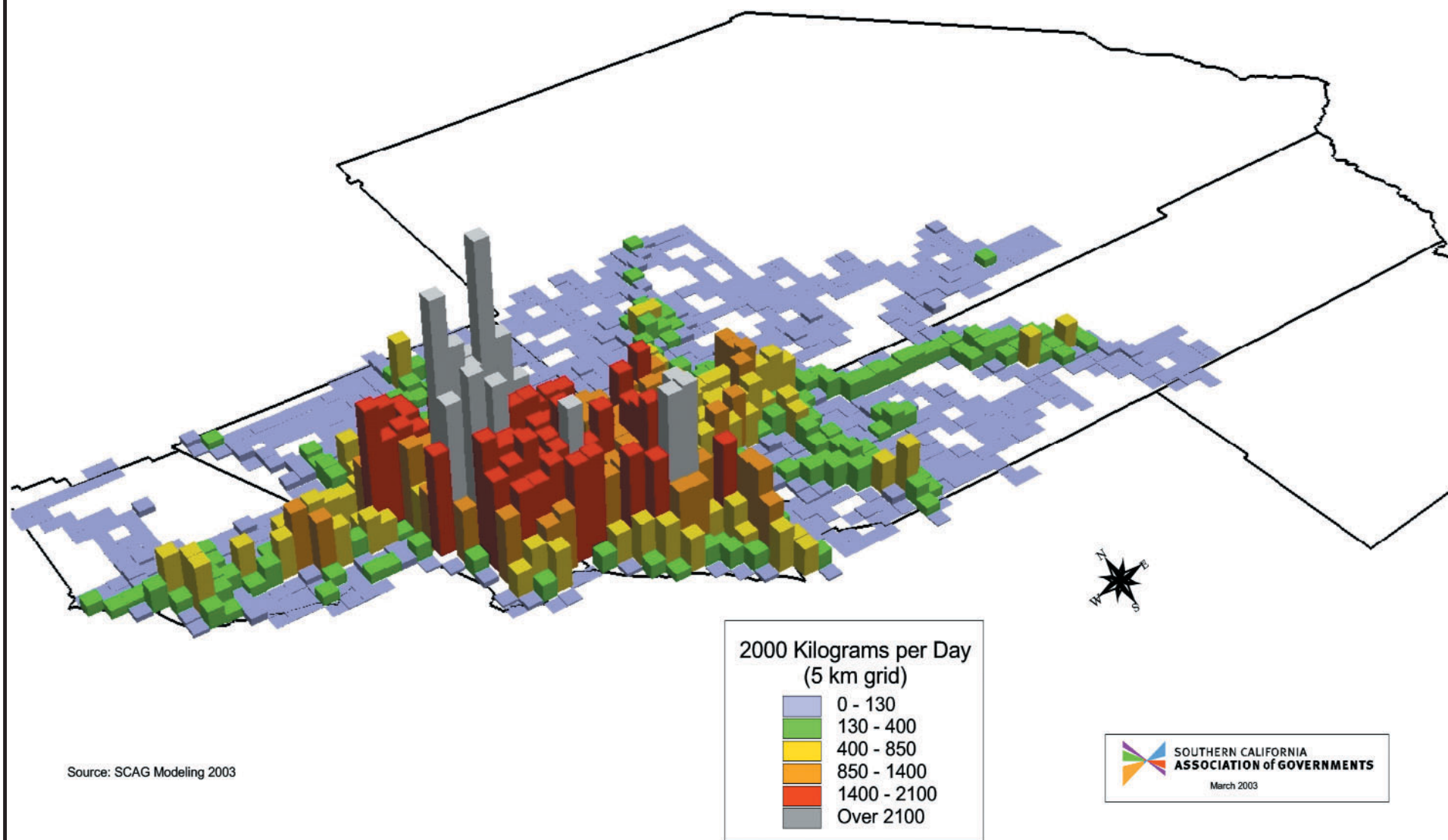
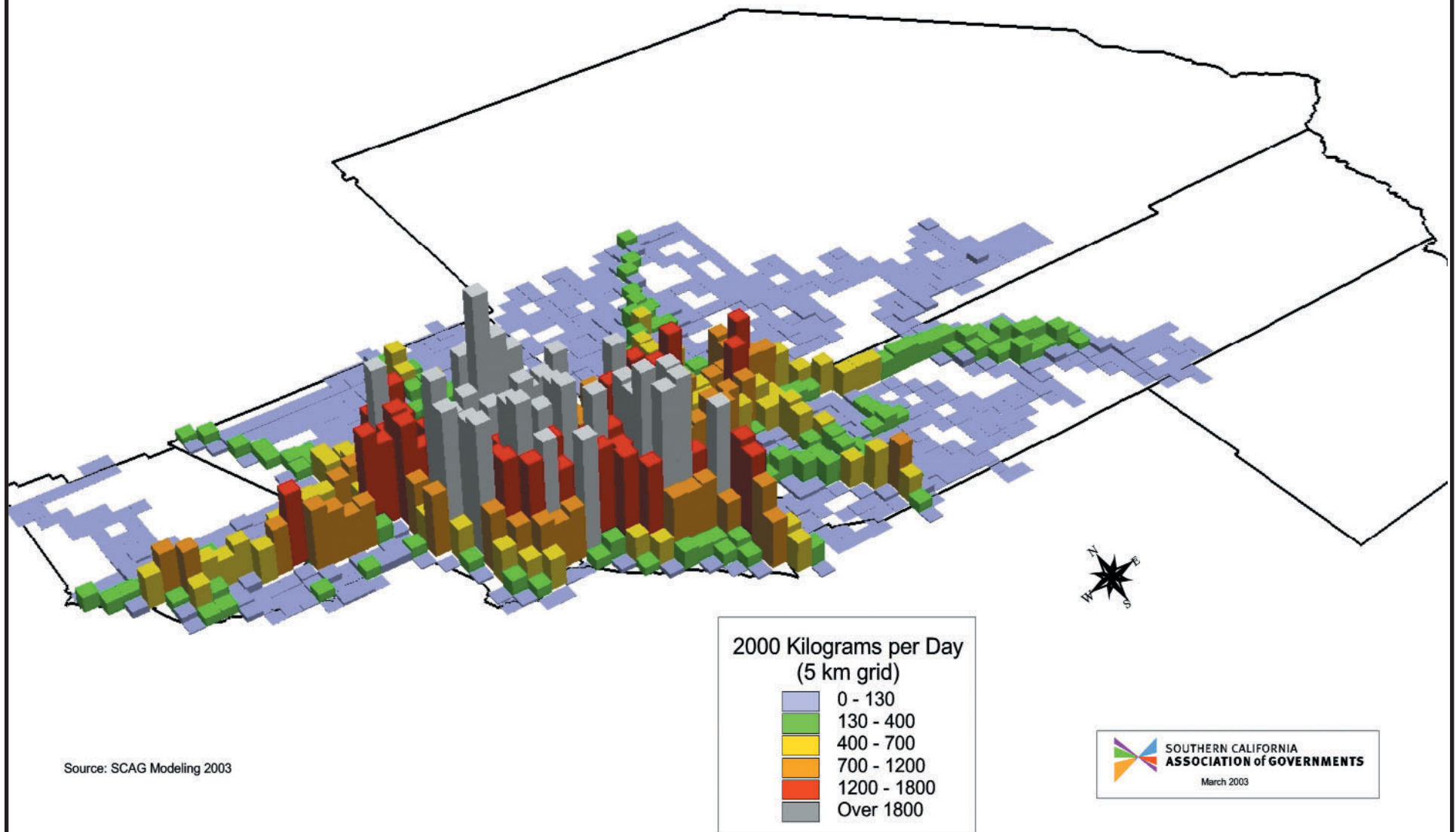


Figure 9-4

Oxides of Nitrogen Emission





Appendices



Socioeconomic Variables Definitions

Appendix A

2

This Appendix provides additional detail to precisely define the socioeconomic input variables used in the 2000 Regional Model.

This clarifying information will be of interest particularly to those familiar with the form and structure of demographic census data, and particularly the 2000 Census, and who wish to understand exactly how the SCAG socioeconomic variables correspond to specific source file variables in the 2000 Census.

Clarifying detail is provided for these socioeconomic input variables:

- Total Population
- Group Quarters Population
- Resident Population
- Workers
- Single Households
- Multiple Households
- Median Household Income

Total Population

The Total Population living in the Traffic Analysis Zone, including all population types enumerated by the U.S. Census. Comparable in definition to 2000 Census STF1 Table P1.

Group Quarters Population

The “noninstitutionalized” Group Quartered Population, comparable in definition to 2000 Census Table P37.

Resident Population

The population NOT living in “group quarters”, comparable in definition to 2000 Census STF Table P16, population in household.

Workers

Total number of employed persons residing in a traffic analysis zone. Workers are Civilian Workers, Employed Civilian Population 16 years and over from 2000 Census SF3, the first item of P49.

Single Households

The number of households in permanent single-family homes with detached roofs (commonly known as “single family, owner/renter occupied”) Comparable in definition to 2000 Census STF3: Table H32.

Multiple Households

The number of all other households not in the single household category, including housing with “attached” roofs, and including condominiums, duplexes, triplexes, apartments, mobile homes, and other types of “dwellings” (including houseboats, RV’s, tents, etc.). Multiple Households is Total Households minus Single Households. The Multiple Household variable is comparable in the definition to 2000 Census STF1 Table H32 from one attached to Boat, RV, Van (owner/renter occupied).

Median Households Income

The median value of household income for all households in the zone. Household income includes the income, from all sources, for all persons aged 15 years or older within a household. The household income variable is comparable in definition to 2000 Census STF3 Table P53. For reasons related to the evolution of the SCAG Regional Model, the Median Household Income dollar level is adjusted to be expressed in the equivalent of “1989 dollars”, which then becomes the “Median Household Income” input variable to the Model.

Employment Variable Definitions

The generation model uses 3 categories of employment; Retail, Service, and Basic (all other). The employment variables are based on the Standard Industrial Classification (SIC) system. The 2-digit SIC codes are aggregated as follows to create the 3 employment variables used by the Model:

- Retail Employment – SIC Categories 52 – 59
- Service Employment – SIC Categories 70 – 89
- Basic Employment – SIC Categories 1-51, 60-69, 90-99

Standard Industrial Classification, 2 Digit Employment Codes

- 1 = “agricultural production crops”
- 2 = “agricultural production; livestock”
- 7 = “agricultural services”
- 8 = “forestry”
- 9 = “hunting and trapping”
- 10 = “metal mining”
- 12 = “coal mining”
- 13 = “oil and gas extraction”
- 14 = “mining and quarrying of nonmetallic”
- 15 = “construction”
- 16 = “heavy construction other than builders”
- 17 = “construction special trade contractors”
- 20 = “food and kindred products”

- 21 = “tobacco products”
- 22 = “textile mill products”
- 23 = “apparel and other finished product”
- 24 = “lumber and wood products”
- 25 = “furniture and fixtures”
- 26 = “paper and allied products”
- 27 = “printing and publishing”
- 28 = “chemical and allied products”
- 29 = “petroleum refining and related industries”
- 30 = “rubber and miscellaneous plastic products”
- 31 = “leather and leather products”
- 32 = “stone; clay; glass; and concrete products”
- 33 = “primary metals industries”
- 34 = “fabricated metal products;”
- 35 = “industrial and commercial machinery”
- 36 = “electronic and other electrical”
- 37 = “transportation equipment”
- 38 = “measuring; analyzing; and control”
- 39 = “miscellaneous manufacturing industry”
- 40 = “railroad transportation”
- 41 = “local and suburban transit”
- 42 = “motor freight transportation”
- 43 = “U.S. postal services”
- 44 = “water transportation”
- 45 = “transportation by air”

46 = “pipelines; except natural gas”	75 = “automotive repair; services; and parts”
47 = “transportation services”	76 = “miscellaneous repair services”
48 = “communications”	78 = “motion pictures”
49 = “electric; gas; and sanitary service”	79 = “amusement and recreational service”
50 = “wholesale trade -- durable goods”	80 = “health services ’81 = ‘legal services”
51 = “wholesale trade -- non-durable goods”	82 = “educational services”
52 = “building materials; hardware; garden”	83 = “social services”
53 = “general merchandise stores”	84 = “museums; art galleries; and botanic”
54 = “food stores”	86 = “membership organizations”
55 = “automotive dealers and gasoline”	87 = “engineering; accounting; research”
56 = “apparel and accessories stores”	88 = “private households”
57 = “home furniture; furnishings;”	91 = “executive; legislative; and general”
58 = “eating and drinking places”	92 = “justice; public order; and safety”
59 = “miscellaneous retail”	93 = “finance, taxation, & monetary policy”
60 = “depository institutions“	94 = “administration of human resources”
61 = “non-depository credit institutions”	95 = “administration of environmental quality”
62 = “security and commodity brokers;”	96 = “administration of economic program”
63 = “insurance carriers”	97 = “national security and international”
64 = “insurance agents and brokers”	99 = “nonclassifiable establishments”
65 = “real estate”	
67 = “holding and other investment offices”	
70 = “hotels rooming houses; camps;”	
72 = “personal services”	
73 = “business services”	

The Regional Transportation Analysis Zone System

2

Introduction

The Regional Model's study area includes Los Angeles County, Orange County, Ventura County, and the urbanized portions of Riverside and San Bernardino Counties.

The definition of the Regional Transportation Analysis Zone (TAZ) System is an important aspect of SCAG's model improvement program. The transportation analysis zones are essential components in the transportation model. The TAZs provide the spatial unit (or geographical area) within which travel behavior and traffic generation are estimated. The zone size varies depending on the density and nature of the urban development. The Regional Model includes 3191 zones. (see Table B-1 for a description of the TAZ system).

Methodology

The TAZ system is consistent with both the 1990 census geography and existing subregional TAZs. Within the urban areas the zonal detail will be similar to the census tract. Commercial / industrial areas within the urban area will require further subdividing and large census tracts in developing areas will be split to account for future growth.

The following provides a description of the principles that guided the development of the Regional zone system. The principles were developed using standard modeling practice:

- **Consistency with Existing Subregional Models** - To maintain the zonal hierarchy, the Regional Model TAZs were based directly on existing subregional model TAZs. Subregional TAZs were available for most of the Regional Modeling area. Where subregional zones existed, the Regional TAZs are either a single subregional TAZ or an aggregation of several subregional TAZs.
- **Consistency with 1990 Census Tract Boundaries** - The subregional models' TAZ systems are consistent with 1990 Census geography. All Subregional TAZs are either entire census tracts or are wholly contained within a census tract. Where subregional TAZs did not exist, the Regional TAZs were created respecting census tract boundaries.
- **Consistency with Census Block Boundaries** - The finest level of geography in both the 1990 Census and Subregional Models is the Census Block. To ease data collection and creation, zonal boundaries generally do not break Census Blocks. There are several subregional TAZs in developing rural areas where the TAZs boundaries do split census blocks.
- **Complement the Transportation System** - A critical step in developing the TAZ system is defining the level of roadway facilities for which accurate forecasts are desired. To ensure accurate distribution and traffic assignments, existing and future freeways and principal arterials are generally represented as Regional TAZ boundaries. This effort was balanced against honoring the other zonal creation criteria.

- **Homogeneous Land Use** - Land use maps and general plan maps were used to identify existing and future land use. Ideally, it is best to limit the number of different land uses contained within a zone. However, given the geographic size of the Regional TAZs and mixed use development patterns within the urban area, it was often difficult to create zones with uniform land uses.
- **Similar Population/Employment Size** - Zones were developed to represent similar levels of future development (population and employment). This parameter was not strictly enforced given the sparse development of some areas, the intensity of non-residential land uses within urban areas, and consideration for special generators (example - universities and airports).
- **Other Considerations** - Natural and man made boundaries are also considered in the definition of the zone system. Political jurisdictions, railroad lines, rivers, mountain ranges and other topographical barriers were considered in the development of both the subregional and Regional TAZs.

GIS coverages of subregional TAZ systems were gathered for all the existing subregional models. Draft zonal maps were developed by applying the above principles. The Regional zonal boundaries were manually drafted onto census tract and block maps by comparing overlays of the highway system, land uses, and existing subregional TAZs. Using these highlighted maps, a technician entered the boundaries into a digital file using ARC-INFO. Several editing steps were undertaken to ensure that all subregional TAZs and census blocks were assigned to the proper Regional TAZ. Once a clean zonal boundary file was created, final zone numbers were assigned to the draft TAZ system.

Table B-1

SUMMARY OF TAZ STATISTICS								
Existing Modeling Area	Number of Census Tracts	Number of Modeling Zones	Zone Number Sequence	Cordon Stations	MDAB RSA	SSAB RSA	SCCAB RSA	SCAB RSA
Los Angeles County	1640	1721	200-1920	3196-3202	9,10			7,8,11-27
Orange County	480	549	2296-2844	3217				35-44
Western Riverside	93	263	2845-3107	3213-3216		50		45-51
San Bernardino Valley	128	283	1921-2203	3203-3205				28-30
Ventura County	73	199	1-199	3192-3195			1-6	
Extended Modeling Area								
Coachella/Idyllwild	25	84	3108-3191	3209-3212		51-53		
Victor Valley/Barstow/Morongo	19	92	2204-2295	3206-3208	32,33			
Total	2458	3191		26				

Regional Highway Network Coding Conventions

Appendix C

Table C-1

TRANPLAN HIGHWAY NETWORK FORMAT			
Column	Attribute Name	Range	Definition
1-5	A Node	1-65,500	1-3217 Centroids
6-10	B Node	1-65,500	1-3217 Centroids
11	Assignment Group ¹	0-9	Facility Type
12-15	Distance	In 100ths of Mile	
16	Time or Speed	T/S	
17-20	Initial Time/Speed		
21-24	Free Flow Time/Speed		
25-26	Direction Code		Not Used
27-28	Link Group 1	1-56	RSA ²
29-30	Link Group 2 ³ - (Area Type & Number of Lanes)	Area Type 1 - 7 & Number of Lanes 1 - 7	Col 29 - Area Type, Col 30 - Number of Lanes
31-32	Link Group 3 ⁴	0-99	SCAG Special Codes ⁵
33-38	Capacity		Capacity per Hour
39-44	Not Used		
45	B-A Option		

¹Assignment Group

Code	Definition	Description
	Mix Flow - HOV Connectors	
1	Freeways	
2	Principal Arterials	
3	Minor Arterials	
4	Major Collectors	
5	HOV (2+)	Assignment Group = 5 & Link Group 3 = 90
5	HOV (3+)	
6	Centroid Connectors	
7	Freeway On-Off Ramps	
8	Freeway-Freeway Connectors	
9	Toll Plaza	Assignment Group = 9 & Cost = 9

²Regional Statistical Area (RSA) - Link Group¹

Code	Definition	Description
1-6	Ventura County	
7-27	Los Angeles	
35-43	Orange County	
28-33	San Bernardino County	*RSAs within the Regional Modeling Area
45-53	Riverside County	*RSAs within the Regional Modeling Area
55	Imperial County	

³Area Type - Link Group 2 (Col 29)

Code	Definition	
1	Core	5 Suurban
2	Central Business District	6 Rural
3	Urban Business District	7 Mountain
4	Urban	

⁴Link Group 3

Code	Definition	Description
0	Default	
10 - 15	Grade Codes - Trucks Only Lanes	(See Grade Codes Below)
20 - 25	Grade Codes - Mixed Flow Lanes	(See Grade Codes Below)
71	Divided Street	Assignment Group = 2-4 & Link Group 3=71
72	Signal Progression Optimized Streets	Assignment Group = 2-4 & Link Group 3=72
73	Divided and Signal Optimized	Assignment Group = 2-4 & Link Group 3=73
74	Continuous Left-turn lane	Assignment Group = 2-4 & Link Group 3=74
80	Toll Road	Assignment Group = 1 & Link Group 3=80
81	Mixed-flow Toll Plaza	Assignment Group = 9 & Link Group 3=81
82	HOV Toll Plaza	Assignment Group = 1 & Link Group 3=82
83	FWY Speed = 70 M.P.H	
84	FWY Speed = 55 M.P.H	
90	HOV 3+	
91	Freeway w/Auxiliary lane = 1	Assignment Group = 1 & Link Group 3 = 91
92	Freeway w/Auxiliary lanes > 1	Assignment Group = 1 & Link Group 3 = 92
93	Freeway Collector/Distributor Lanes	Assignment Group = 1 & Link Group 3 = 93
98 & 99	No Trucks Allowed	

⁵Grade Codes

Code	Definition	
0 & 10	Unspecified	13 & 23 5% - 6%
11 & 21	0% - 2%	14 & 24 3% - 4% (Arterial)
12 & 22	3% - 4% (Freeway)	15 & 25 > 6%

Specification of Trip Production Models

Appendix D

2

Tables D-1 through D-10 in this Appendix present the cross-classification trip production models employed in the Year 2000 SCAG Regional Model. Listed below are the trip production models presented in this Appendix, by trip purpose:

Table D-1 Home-Based Work – Direct Trip Productions

Table D-2

Home-Based Work – Strategic Trip Productions

Table D-3

Home-Based Elementary-High School Trip Productions

Table D-4

Home-Based College/ University Trip Productions

Table D-5

Home-Based Shopping Trip Productions

Table D-6

Home-Based Social-Recreation Trip Productions

Table D-7

Home-Based Other Trip Productions

Table D-8

Other-Based Other Trip Productions

Table D-9

Work-Based Other Trip Productions

Table D-10

Home-Based Work-at-Home Trip Productions

Table D-1

HOME-BASED WORK-DIRECT TRIP PRODUCTION MODEL

Number of Workers in Household	Income Group (1990 \$)	Household Size					
		1	2	3	4	5	6+
0	\$0 - \$19,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$20,000 - \$49,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$50,000 or more	0.00	0.00	0.00	0.00	0.00	0.00
1	\$0 - \$19,999	1.12	1.25	1.10	1.19	1.14	1.44
	\$20,000 - \$49,999	1.14	1.27	1.12	1.21	1.16	1.46
	\$50,000 or more	1.10	1.23	1.08	1.17	1.12	1.42
2	\$0 - \$19,999	0.00	2.20	2.05	2.14	2.09	2.39
	\$20,000 - \$49,999	0.00	2.22	2.07	2.16	2.11	2.41
	\$50,000 or more	0.00	2.18	2.03	2.12	2.07	2.37
3 or more	\$0 - \$19,999	0.00	0.00	3.70	3.79	3.74	4.04
	\$20,000 - \$49,999	0.00	0.00	3.72	3.81	3.76	4.06
	\$50,000 or more	0.00	0.00	3.68	3.77	3.72	4.02

Table D-2

HOME-BASED WORK-STRATEGIC TRIP PRODUCTION MODEL							
Number of Workers in Household	Income Group (1990 \$)	Household Size					
		1	2	3	4	5	6+
0	\$0 - \$19,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$20,000 - \$49,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$50,000 or more	0.00	0.00	0.00	0.00	0.00	0.00
1	\$0 - \$19,999	0.06	0.01	0.21	0.23	0.28	0.23
	\$20,000 - \$49,999	0.09	0.04	0.24	0.26	0.31	0.31
	\$50,000 or more	0.09	0.04	0.24	0.26	0.31	0.31
2	\$0 - \$19,999	0.00	0.23	0.43	0.45	0.50	0.45
	\$20,000 - \$49,999	0.00	0.26	0.46	0.48	0.53	0.48
	\$50,000 or more	0.00	0.26	0.46	0.48	0.53	0.48
3 or more	\$0 - \$19,999	0.00	0.00	0.34	0.36	0.41	0.36
	\$20,000 - \$49,999	0.00	0.00	0.37	0.39	0.44	0.39
	\$50,000 or more	0.00	0.00	0.37	0.39	0.44	0.39

Table D-3

HOME-BASED ELEMENTARY/HIGH SCHOOL TRIP PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.01	0.19	0.84	1.64	2.17	3.20
1	0.01	0.19	0.84	1.64	2.17	3.20
2	0.02	0.05	0.64	1.77	2.84	3.57
3	0.04	0.06	0.37	1.44	2.09	2.62
4 or more	0.00	0.01	0.42	0.92	1.04	1.64

Table D-4

HOME-BASED COLLEGE/UNIVERSITY SCHOOL TRIP PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.03	0.09	0.26	0.34	0.58	0.90
1	0.03	0.09	0.26	0.34	0.58	0.90
2	0.03	0.09	0.26	0.34	0.58	0.90
3	0.13	0.07	0.31	0.62	1.02	1.07
4 or more	0.13	0.07	0.31	0.62	1.02	1.07

Table D-5

HOME-BASED SHOP TRIP PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.60	0.70	0.45	1.10	0.74	0.78
1	0.52	0.93	0.79	0.85	0.68	0.92
2	0.53	0.89	0.90	1.10	1.20	1.29
3	0.47	0.90	1.04	1.10	1.37	1.36
4 or more	0.23	0.72	0.94	1.07	1.24	0.85

Table D-6

HOME-BASED SOCIAL-RECREATION TRIP PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.42	0.65	0.80	0.46	0.92	0.34
1	0.49	0.78	0.85	1.11	1.03	1.64
2	0.49	0.81	0.98	1.34	1.80	1.91
3	0.61	0.78	1.17	1.44	0.00	2.24
4 or more	0.24	0.63	1.08	1.73	1.84	1.71

Table D-7

HOME-BASED OTHER TRIPS PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.67	1.08	1.36	1.07	1.30	1.30
1	1.05	1.67	1.86	1.93	2.13	2.13
2	1.13	1.87	1.99	2.70	3.05	3.05
3	1.22	1.86	2.21	2.84	3.20	3.20
4 or more	1.22	1.86	2.21	2.84	3.20	3.20

Table D-8

OTHER-BASED OTHER TRIPS PRODUCTION MODEL						
Auto ownership	Household Size					
	1	2	3	4	5	6+
0	0.57	0.98	0.95	0.98	1.06	1.06
1	1.41	1.92	1.92	1.98	1.88	1.88
2	1.45	2.06	2.29	2.90	3.20	3.20
3	1.30	2.18	2.63	3.11	3.26	3.26
4 or more	1.30	2.18	2.63	3.11	3.26	3.26

Table D-9

WORK-BASED OTHER TRIPS PRODUCTION MODEL							
Number of Workers in Household	Income Group (1990 \$)	Household Size					
		1	2	3	4	5	6+
0	\$0 - \$19,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$20,000 - \$49,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$50,000 or more	0.00	0.00	0.00	0.00	0.00	0.00
1	\$0 - \$19,999	.92	0.73	0.63	0.57	0.50	0.48
	\$20,000 - \$49,999	1.16	0.98	0.87	0.80	0.74	0.72
	\$50,000 or more	1.52	1.34	1.24	1.17	1.10	1.09
2	\$0 - \$19,999	0.00	1.47	1.36	1.30	1.24	1.22
	\$20,000 - \$49,999	0.00	1.71	1.61	1.53	1.47	1.46
	\$50,000 or more	0.00	2.08	1.97	1.90	1.84	1.83
3 or more	\$0 - \$19,999	0.00	0.00	1.93	1.87	1.80	1.79
	\$20,000 - \$49,999	0.00	0.00	2.16	2.10	2.04	2.03
	\$50,000 or more	0.00	0.00	2.53	2.47	2.40	2.39

Table D-10

HOME-BASED WORK-AT-HOME TRIP PRODUCTION MODEL							
Number of Workers in Household	Income Group (1990 \$)	Household Size					
		1	2	3	4	5	6+
0	\$0 - \$19,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$20,000 - \$49,999	0.00	0.00	0.00	0.00	0.00	0.00
	\$50,000 or more	0.00	0.00	0.00	0.00	0.00	0.00
1	\$0 - \$19,999	0.0645	0.0645	0.0645	0.0645	0.0645	0.0645
	\$20,000 - \$49,999	0.0645	0.0645	0.0645	0.0645	0.0645	0.0645
	\$50,000 or more	0.0645	0.0645	0.0645	0.0645	0.0645	0.0645
2	\$0 - \$19,999	0.0000	0.1411	0.1411	0.1411	0.1411	0.1411
	\$20,000 - \$49,999	0.0000	0.1411	0.1411	0.1411	0.1411	0.1411
	\$50,000 or more	0.0000	0.1411	0.1411	0.1411	0.1411	0.1411
3 or more	\$0 - \$19,999	0.0000	0.0000	0.1411	0.1411	0.1411	0.1411
	\$20,000 - \$49,999	0.0000	0.0000	0.1411	0.1411	0.1411	0.1411
	\$50,000 or more	0.0000	0.0000	0.1411	0.1411	0.1411	0.1411

Specification of Trip Attraction Models



Table E-1 in this Appendix presents the regression coefficients for the trip attraction models employed in the Year 2000 SCAG Regional Model. Table D-1 “reads across” for each trip purpose. Separate regression equations are employed for the following trip purposes:



- Home-Based Work – Direct Trip Attractions (Separate equations for low, medium, and high income)
- Home-Based Work – Strategic Trip Attractions (Separate equations for low, medium, and high income)



- Home-Based Elementary-High School Trip Attractions
- Home-Based College/University Trip Attractions
- Home-Based Shopping Trip Attractions
- Home-Based Social-Recreation Trip Attractions
- Home-Based Other Trip Attractions
- Work-Based Other Trip “Allocations”: Production “Allocations” Attractions “Allocations”
- Other-Based Other Trip Attractions



Table E-1

TRIP ATTRACTION MODEL REGRESSION COEFFICIENTS

Trip Purpose	Household		Employment			Enrollment	
	SFU	MFU	Basic	Retail	Service	Elementary	University
HBW-Direct							
Low Income			0.186	0.172	0.146		
Middle Income			0.429	0.491	0.399		
High Income			0.489	0.452	0.501		
HBW-Strategic							
Low Income			0.024	0.022	0.018		
Middle Income			0.0590	0.052	0.069		
High Income			0.066	0.050	0.082		
Home-Based School							
Elementary-High School						1.459	
College & University							1.459
Home-Based Shop				4.303	0.012		
Home-Based Social-Recreational	0.129	0.088		4.063	0.112		
Home-Based Other	0.618	0.478	0.551	2.287	1.131		
Work-Based Other							
“Production-Allocation”			0.479	2.323	0.479		
“Attraction-Allocation”	0.128	0.096	0.741	1.708	0.967		
Other-Based Other	0.471	0.358	0.836	5.385	1.713		

Specification of Mode Choice Models

2

Introduction

This Appendix presents the specification of the mode choice models employed in the Year 2000 SCAG Regional Model. Separate mode choice models are employed for the following trip purposes:

- Home-Based Work
- Home-Based Other
- Home Based School
- Work-Based Other
- Other-Based Other

The Home-Based Work, Home-Based School, and Other-Based Other mode choice models are constrained nested logit models. The Home-Based Other and Work-Based Other mode choice models are constrained multinomial logit models.

Home-Based Work Mode Choice Model

The structure of the Home-Based Work mode choice model is illustrated in Figure E-1, and the regression coefficients for the variables in the model, by mode estimated, are presented in Table E-1. The predictive variables employed in the Home-Based Work model are:

- LOS, or Level of Service, for three different household income levels.
 - Level of Service is defined as:
 - In-vehicle time,
 - Plus 2.5 times out-of vehicle time,

Plus cost/value-of-time.

The value of time used is:

\$1.34 for low income,
\$4.25 for medium income, and
\$10.15 for high income.

- Autos per Person
- Income (annual household income in thousands of dollars)
- Population Density (population density applied to the production zone)

Home-Based Other Mode Choice Model

The structure of the Home-Based Other mode choice model is illustrated in Figure E-3, and the regression coefficients for the variables in the model, by mode estimated, are presented in Table E-3. The predictive variables employed in the Home-Based Other model are:

- LOS, or Level of Service as defined earlier, except only using average annual income)
- Autos per Person
- Income (annual household income in thousands of dollars)
- Population Density (population density applied to the production zone)
- Household Size
- Peak Period Dummy
- CBD Dummy Variable comes into play if the attraction zone is the CBD)

- XY Distance (distance between origin and destination, measured along east-west and north-south legs of the direct path between the origin and destination)
- Peak Period Dummy
- CBD Dummy Variable (comes into play if the attraction zone is the CBD)
- XY Distance (distance between origin and destination, measured along east-west and north-south legs of the direct path between the origin and destination)

Home-Based School Mode Choice Model

The structure of the Home-Based School mode choice model is illustrated in Figure E-2, and the regression coefficients for the variables in the model, by mode, are presented in Table E-2. The predictive variables employed in the Home-Based School model are:

- LOS, or Level of Service (only using annual average income)
- In-Vehicle Travel Time (in minutes)
- XY Distance (distance between origin and destination, measured along east-west and north-south legs of direct path between origin and destination)
- Distance < 3 Miles (a dummy variable equal to one if the "single occupant vehicle" distance between origin and destination is less than 3 miles)
- Autos per Person

- Population Density (population density applied to the production zone)
- Employment Density (employment density applied to the attraction zone)
- Household Size
- Peak Period Dummy

Work-Based Other Mode Choice Model

The structure of the Work-Based Other mode choice model is illustrated in Figure E-4, and the regression coefficients for the variables in the model, by mode, are presented in Table E-4. The predictive variables employed in the Work-Based Other mode are:

- LOS: Level of service
- XY Distance (distance between origin and destination, measured along east-west and north-south legs of the direct path between the origin and destination)
- Population Density (population density applied to the production zone)
- CBD Dummy Variable (comes into play if the attraction zone is the CBD)
- CBD Productions
- Employment Production (employment density applied to the production zone)

Other-Based Other Mode Choice Model

The structure of the Other-Based Other mode choice model is illustrated in Figure E-5, and the regression coefficients for the variables in the model, by mode, are presented in Table E-5. The predictive variables employed in the Other-Based Other model are:

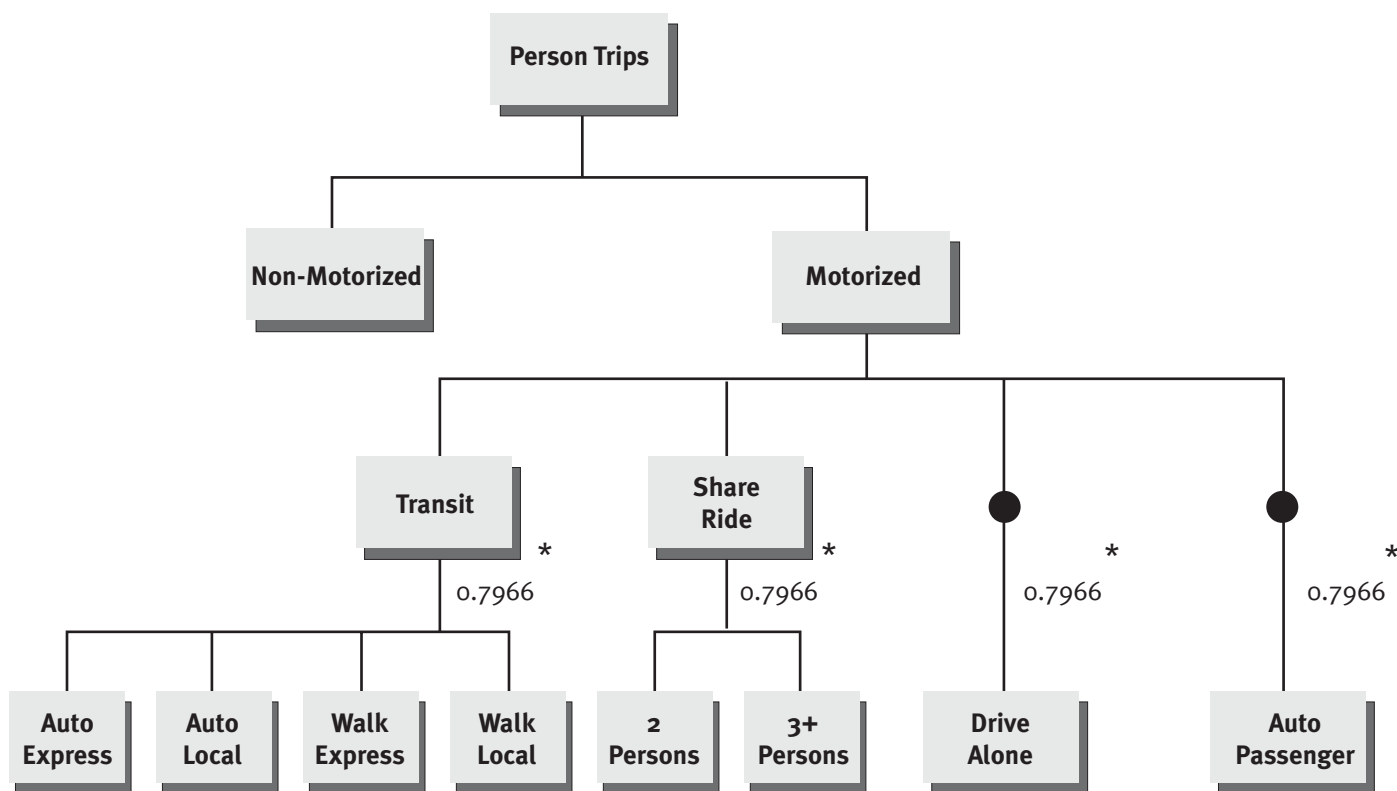
- XY Distance (distance between origin and destination, measured along east-west and north-south legs of the direct path between the origin and destination)
- LOS, Level of Service
- Population Density (population density applied to the production zone)
- Employment Density (employment density applied to both the production and attraction zone)

Table F-1

MODE CHOICE MODEL UTILITY FUNCTIONS HOME-BASED WORK												
TRAVEL MODE	CONSTANTS		COEFFICIENTS									
	PEAK	OFF-PEAK	LOS LOW	LOS MED	LOS HIGH	AUTOS PER PERSON	INCOME	POPULATION DENSITY	EMPLOYMENT DENSITY	HOUSEHOLD SIZE	CBD	XY DISTANCE
Non Motorized	0.4590	0.5186				-0.6025	-0.0063	0.0118			0.6988	-1.0440
Drive Alone	0.0000	0.0000	-0.0165	-0.0210	-0.0373							
Auto Passenger	-3.1509	-3.1460	-0.0165	-0.0210	-0.0373	-1.141				0.2735	0.0277	
Auto Driver/ 2 Occupants	-3.3358	-3.3140	-0.0165	-0.0210	-0.0373	-0.9034				0.0643	0.4820	
Auto Driver/ 3 Occupants	-5.4842	-5.5052	-0.0165	-0.0210	-0.0373	-1.398				0.4978	0.6189	
Local Transit/Walk Access	1.7129	1.4756	-0.0165	-0.0210	-0.0373	-3.999	-0.0545				1.9900	
Local Transit/Auto Access	-2.4972	-2.2373	-0.0165	-0.0210	-0.0373	-1.311	-0.0251				1.9900	
Exprs Transit/Walk Access	-2.1686	-2.8153	-0.0165	-0.0210	-0.0373	-3.464	-0.0496		0.0066		0.6742	
Exprs Transit/Auto Access	-1.4125	-2.5764	-0.0165	-0.0210	-0.0373	-2.220	-0.0278		0.0103		0.6742	

Figure F-1

SCAG MODE CHOICE MODEL STRUCTURE: HOME-BASED WORK



* Nesting Coefficient

Table F-2

MODE CHOICE MODEL UTILITY FUNCTIONS HOME-BASED SCHOOL											
TRAVEL MODE	CONSTANTS		COEFFICIENTS								
	PEAK	OFF-PEAK	LOS	IN VEHICLE TRAVEL TIME	XY DISTANCE	DISTANCE : 3 MILES	AUTOS PER PERSON	POPULATION DENSITY	EMPLOYMENT DENSITY	HOUSEHOLD SIZE	PEAK PER'D DUMMY
Non Motorized	3.1314	1.6234			-2.965						0.1173
Auto Passenger	0.0000	0.0000	-0.01741								
School Bus	1.1866	0.5155		-0.00981		-0.8027	-1.322	-0.0489	-0.0898	-0.0907	-0.49
Local Transit/Walk Access	5.6573	1.1733	-0.01741				-7.516			-2.183	-2.573
Local Transit/Auto Access	0.8823	-2.3365	-0.01741				-9.276			-2.781	-1.365

Figure F-2

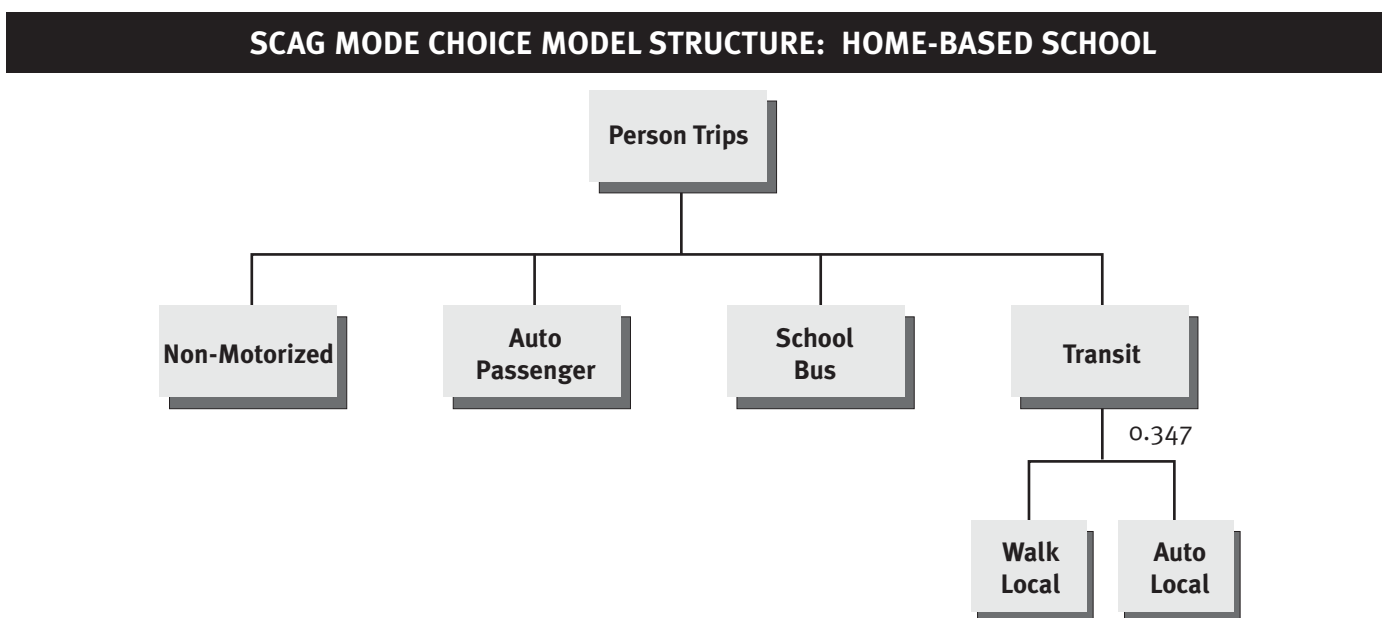


Table F-3

MODE CHOICE MODEL UTILITY FUNCTIONS: HOME-BASED OTHER									
TRAVEL MODE	CONSTANTS		COEFFICIENTS						
	PEAK	OFF-PEAK	LOS	AUTOS PER PERSON	INCOME	POPULATION DENSITY	HOUSEHOLD SIZE	CBD DUMMY VARIABLE	XY DISTANCE
Non Motorized	-0.6552	-0.8619		0.6758	-0.0070				-0.0771
Drive Alone	0.0000	0.0000	-0.0090						
Auto Passenger	-0.7156	-0.8378	-0.0090	-0.3147	-0.0014		0.1968	0.8184	
Auto Driver/ 2 Occupants	-1.2067	-1.2107	-0.0090	-0.6642	-0.0004		0.1159	0.4055	
Auto Driver/ 3 Occupants	-2.7995	-3.0058	-0.0090	-1.734	-0.0004		0.6659	0.5333	
Local Transit/Walk Access	0.1035	-0.2857	-0.0090	-2.5930	-0.0446	0.0377		3.111	
Local Transit/Auto Access	-6.1762	-6.2249	-0.0090	-2.049	-0.0870	0.0377		3.357	
Exprs Transit/Walk Access	-2.0459	-1.4108	-0.0090	-1.522	-0.0346	0.0377		2.753	
Exprs Transit/Auto Access	-2.9753	-2.9197	-0.0090	-0.7086	-0.0282	0.0377		2.753	

Table F-4

MODE CHOICE MODEL UTILITY FUNCTIONS WORK-BASED OTHER								
TRAVEL MODE	CONSTANTS		COEFFICIENTS					
	PEAK	OFF-PEAK	LOS	XY DISTANCE	POPULATION DENSITY	CBD DUMMY VARIABLE	CBD PRODUCTIONS	EMPLOYMENT PRODUCTIONS
Non Motorized	-2.2261	-1.3351		-0.6555	0.0404		3.455	
Drive Alone	0.0000	0.0000	-0.0073					
Auto Passenger	-2.1260	-1.4400	-0.0073					0.0039
Auto Driver/ 2 Occupants	-2.6296	-2.1085	-0.0073					
Auto Driver/ 3 Occupants	-3.7680	-2.9364	-0.0073					
Transit/Walk Access	-4.9079	-5.0178	-0.0073		-0.0483	0.5026	1.667	
Transit/Auto Access	-7.2638	-9.2799	-0.0073			0.5026	4.828	

Figure F-3

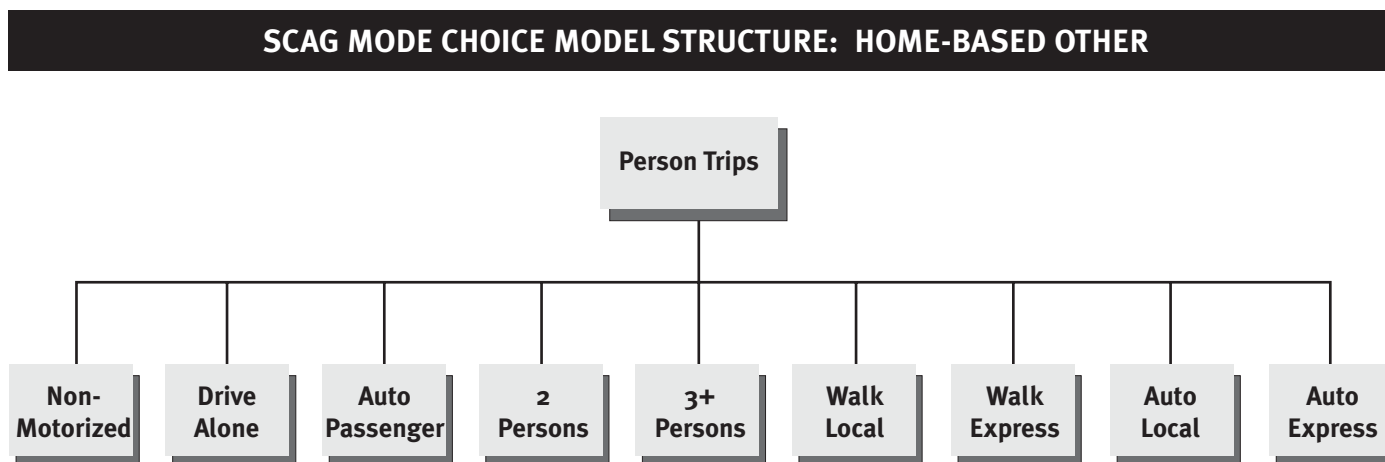


Figure F-4

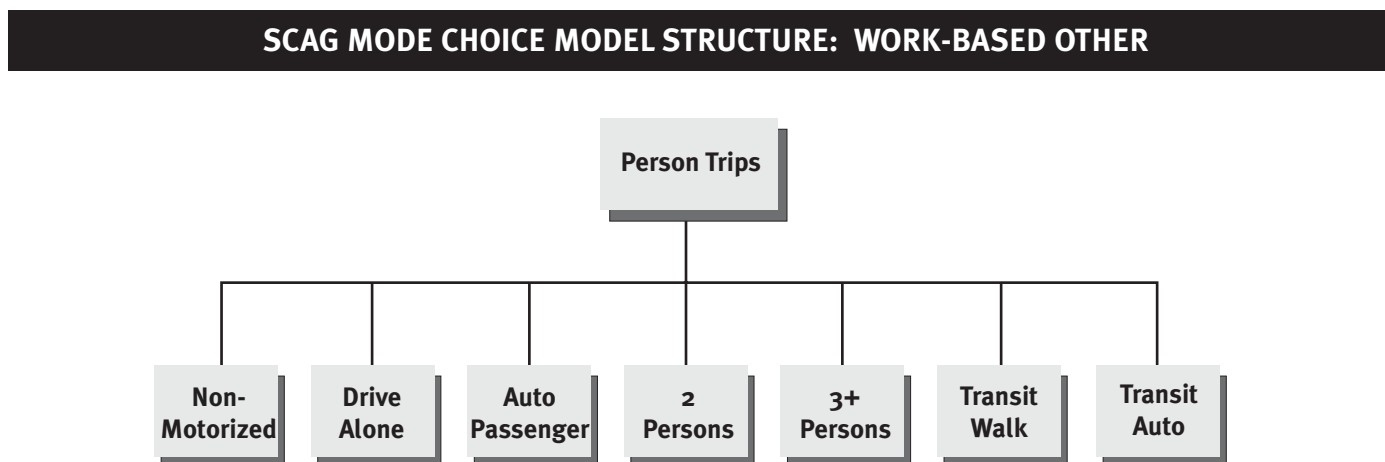
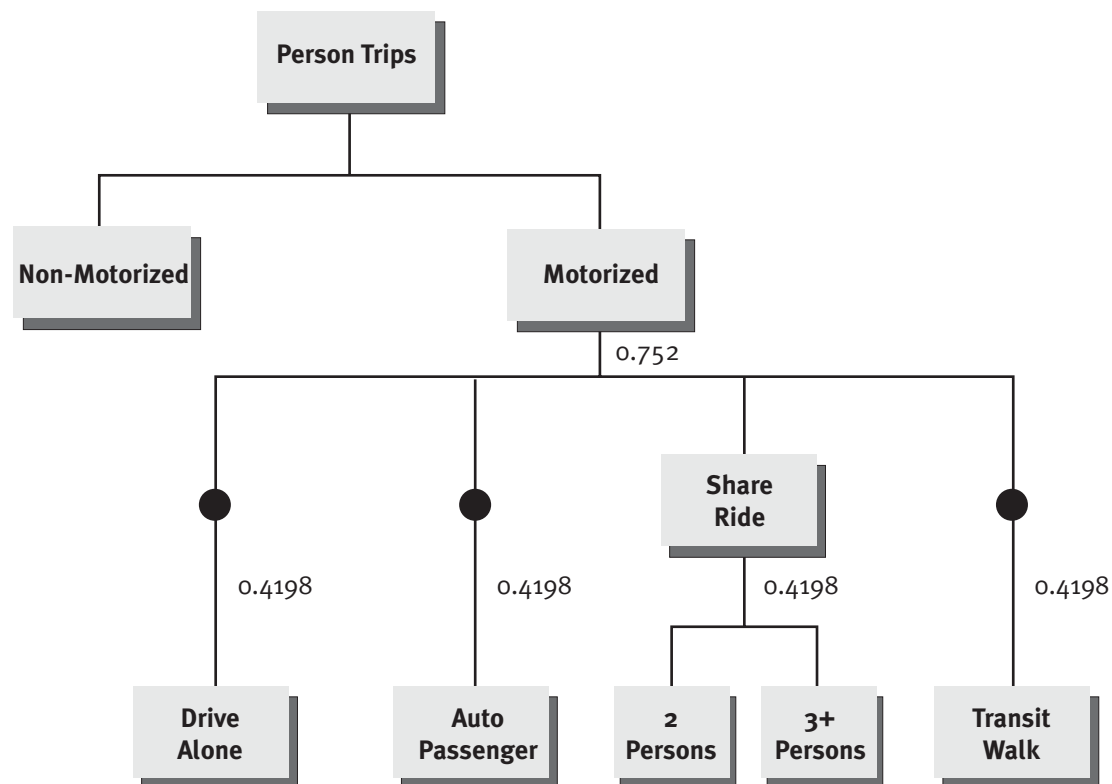


Table F-5

MODE CHOICE UTILITY FUNCTIONS OTHER-BASED OTHER						
TRAVEL MODE	CONSTANTS		COEFFICIENTS			
	PEAK	OFF-PEAK	XY DISTANCE	LOS	POPULATION DENSITY	EMPLOYMENT DENSITY
Non Motorized	-1.7388	-1.6652	-0.8752		0.0351	0.0059
Drive Alone	0.0000	0.0000		-0.0503		
Auto Passenger	-0.8530	-1.0293		-0.0503		
Auto Driver/ 2 Occupants	-2.2223	-2.2698		-0.0503		
Auto Driver/ 3 Occupants	-2.9245	-3.0040		-0.0503		
Transit/Walk Access	-5.0775	-4.3730		-0.0503		

Figure F-5

SCAG MODE CHOICE MODEL STRUCTURE: OTHER-BASED OTHER

Auto Operating Costs

2

Auto operating cost (in cents/mile) is a key parameter in the calculation of the marginal utility cost functions used in mode choice. In the current mode split model, auto operating cost is defined as an out-of-pocket expense consisting of a gasoline cost and “other” costs. Other costs include repairs, maintenance, tires, and accessories.

0

Table G-1 summarizes the Year 2000 auto operation cost calculation and gives the values of the intermediate parameters. The calculation of the fuel cost per mile requires the composite fuel economy for the fleet and an average motor fuel price. On-road Miles Per Gallon (MPG), which reflects actual road use in urban areas, for each model year of the 2000 fleet, for light and medium duty

personal (non-fleet) vehicles in the SCAG Region was used by the CEC to calculate the average miles per gallon. The average price of a gallon of motor vehicle fuel was calculated as the sum of the prices of each grade sold, weighted by its fractional share of the market (Table F-2). The average fuel cost, including all taxes, for May-June 2000 was 171 cents per gallon, which equates to 128 cents per gallon in 1989 constant dollars. The market share data and retail fuel prices were provided by the Fuels Planning Office of the CEC. Sales tax was weighted by the proportion of fuel sold by county. The 5.8 cents-per-mile fuel cost (in 1989 cents, Table F-1) for Year 2000 is higher than the 5.18 cents per mile for 1994 (as calculated using the same method as in this report).

Table G-1

AUTO OPERATING COST CALCULATION

Parameter	Value	Based on
2000 On-road miles/gallon	22	MPG for SCAG Region (CEC)
Avg. Year 2000 cents/gallon	171	Price & volume sold by fuel grade
Converted to 1989_cents*/gallon	128	(See Table F-2)
FUEL COST (1989_cents/mile)	5.804	gallon/mile * cents/gallon
OTHER COSTS (1989_cents/mile)	4.704	Repairs, maint., tires, accessories
TOTAL COST/MILE (1989 cents)	10.507	

* 1989/1997 CPI = 128.3/160.0

The Year 2000 Model Validation uses the value of 4.7 cents per mile (in 1989 dollars) for “other costs” as calculated by SCAG’s Economic Analysis Section using data compiled by the General Services Administration and the National and Southern California AAA. “Other costs” are

weighted by the percentages of vehicle types (determined by VIN number) in the SCAG Year 2000 fleet given by the California Energy Commission (CEC) based on DMV data. Adding 4.7 cents per mile for “other” costs, yields a total auto operating cost of 10.5 cents per mile (reference Table F-1).

Table G-2

YEAR 2000 AVERAGE PRICE OF MOTOR FUEL IN CALIFORNIA*			
Fuel Grade	Unweighted Price (cents, incl. tax)	Market Fraction	Weighted Price (cents, incl. tax)
Regular Unleaded	166.3	0.67201	112
Mid-Grade Unleaded	176.6	0.16953	30
Premium Unleaded	186.7	0.12932	24
No. 2 Diesel	168.7	0.02913	5
Total		1.00000	171
		1989 \$	128

*Market shares and retail fuel prices from data provided by Fuels Planning Office, CEC.
Sales tax is applied after adding state and federal taxes, except for diesel.
Sales tax weighted by proportion of fuel sold by county.

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